

# ASSESSMENT OF THE IMPACT OF POLLUTANTS ON WATER QUALITY IN THE LAKES ACROSS KARNATAKA

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**ABSTRACT:-** Karnataka's lakes are facing severe pollution threats, impacting water quality and ecosystem health. This study investigates the pollution-induced changes in water quality of selected lakes in Karnataka. The results show significant variations in water quality parameters, including salinity, dissolved oxygen and total dissolved solids. The study identifies industrial effluents, agricultural runoff, and domestic sewage as major pollution sources. The study highlights the need for effective pollution control measures and sustainable lake management practices to restore the water quality and ecosystem health of Karnataka's lakes. Water quality parameters—dissolved oxygen (DO), dissolved organic matter (DOM), total hardness, and dissolved salts—were measured across five Karnataka lakes to assess pollution impacts and ecological conditions. Results showed stark variations, with multiple lakes exhibiting critically low DO indicative of hypoxia, elevated DOM signaling eutrophication risk, and increased hardness and salts reflecting salinity stress from industrial effluents, agricultural runoff, and domestic sewage. These patterns, including hypoxic conditions in 60% of sampled lakes, align with KSPCB (Karnataka State Pollution Control Board) reports from 2020-2023, which documented over 40% of monitored lakes (172 in 2023) as Class E—unfit for any use—due to persistent low DO and organic overloads. The findings underscore the urgent need for pollution controls, remediation efforts like aeration, and sustainable management to prevent biodiversity loss and restore ecosystem health.

**KEYWORDS:** Eutrophication Hypoxia, Lake Ecosystem, pollution control, Water pollution, Water quality

## INTRODUCTION

Lakes are vital freshwater ecosystems that provide numerous ecological, economic, and social benefits. Karnataka, a state in southern India, is home to numerous lakes that support biodiversity, irrigation, drinking water supply, and recreational activities. However, these lakes are facing unprecedented threats from pollution, which is degrading their water quality and ecosystem health. Due to the pollution threats such as the rapid urbanization,

industrialization, and agricultural expansion in Karnataka have led to increased pollution loads in lakes. Industrial effluents, domestic sewage, agricultural runoff, and solid waste dumping are major pollution sources. These pollutants can alter the physical, chemical, and biological characteristics of lake water, posing risks to human health, aquatic life, and the environment. Earlier works, like<sup>3</sup> pond/tank reports, flagged similar hardness and salt elevations statewide, correlating to biodiversity loss in 45% of sites. These



**Fig 1:- Topography of Agara Lake**

**Fig 2:- Topography of Bellandur Lake**



**Fig 4- Topography of Udupi Lake**



**Fig 5:- Topography of Madikeri Lake**

**Fig- 3 Topography of Margondanahalli Lake**

The findings showed notable variation in these parameters among the lakes. The results reveal significant spatial variations in water quality parameters across the five



lakes, reflecting diverse pollution pressures from urbanization, agriculture, and industry.

### **Dissolved Oxygen (DO)**

DO levels ranged from hypoxic (1.425 mg/L in Bellandur Lake) to supersaturated (8.556 mg/L in Madikeri Lake), indicating severe oxygen depletion in urbanized areas. Bellandur Lake exhibited the most critical issue, with DO below 2 mg/L, signaling hypoxia that can lead to fish kills and anaerobic conditions, as reported in similar polluted systems (Ramakrishna & Dhananjaya, 2018). This severe environmental issue is justified by its proximity to industrial and sewage inputs, exacerbating microbial respiration. In contrast, Madikeri Lake's high DO suggests minimal pollution, supporting biodiversity, but contradicts expectations for rural lakes, which often face agricultural runoff-induced eutrophication<sup>8</sup>. Agara and Margondanahalli Lakes showed moderate DO (2.853 mg/L), indicating mild stress from urban runoff, while Udupi Lake (4.275 mg/L) reflected moderate pollution,

## **RESULT AND DISCUSSION**

Water quality parameters—dissolved oxygen, dissolved organic matter, total hardness, and dissolved salts—were measured across five lakes to assess their ecological conditions.

potentially from nutrient loading. Comparatively, urban lakes (Bellandur, Agara) had lower DO than rural ones (Madikeri), aligning with literature on anthropogenic hypoxia (Schindler, 2006), but the high DO in Madikeri despite elevated DOM highlights contradictory natural aeration (e.g., wind or inflows) mitigating pollution effects. (2021), necessitating aeration for restoration.

### **Dissolved Organic Matter (DOM)**

DOM concentrations varied from 1.4 mg/L (Bellandur Lake) to 2.6 mg/L (Madikeri Lake), with higher values indicating organic pollution. Madikeri Lake's elevated DOM suggests nutrient enrichment, potentially from agricultural sources, posing moderate environmental risks like algal blooms and microbial growth, which can degrade water clarity and oxygen (Thurman, 1985). This contradicts its high DO, possibly due to efficient decomposition or dilution from forested inflows, unlike urban lakes where DOM correlates with low DO. Bellandur Lake's lower DOM is surprising given its severe pollution, but may reflect rapid microbial consumption in hypoxic zones, a contradictory pattern seen in eutrophic systems<sup>10</sup>. Agara (1.6 mg/L) and Margondanahalli (1.8 mg/L) showed mild DOM issues from industrial runoff, while Udupi (2 mg/L) indicated moderate agricultural inputs. Comparatively, rural lakes (Udupi, Madikeri) had higher DOM than urban ones (Bellandur), opposing urban-centric pollution narratives and highlighting diffuse sources<sup>2</sup>.

### **Total Hardness**

Hardness ranged from 1.4 mg/L (Bellandur Lake) to 2.6 mg/L (Madikeri Lake), generally moderate but varying by lake.

Madikeri Lake's high hardness (2.6 mg/L) indicates mineral enrichment, potentially from geological sources, posing mild environmental issues like reduced soap efficacy and metal solubility, but not severe toxicity<sup>6</sup>. This correlates with DOM but contradicts low pollution expectations in rural areas. Bellandur Lake's low hardness (1.4 mg/L) is anomalous for urban sites, where industrial effluents typically elevate it, possibly due to dilution or acidic inputs—a contradictory finding warranting further investigation. Agara (2.41 mg/L) and Udupi (2 mg/L) showed moderate hardness from mixed sources, while Margondanahalli (1.8 mg/L) reflected industrial impacts. Comparatively, hardness was higher in rural lakes, challenging urban pollution dominance and suggesting natural variability<sup>8</sup>.

### **Dissolved Salts**

Salt levels were low overall (0.0716–0.094 mg/L), with Bellandur Lake highest (0.094 mg/L), indicating mild salinity issues from sewage and runoff, potentially stressing osmoregulation in aquatic organisms<sup>4</sup>. This severe issue in Bellandur justifies its classification as highly polluted, unlike Madikeri's low salts (0.078 mg/L), which contradict rural runoff expectations. Margondanahalli's lowest salts (0.0716 mg/L) suggest effective dilution, while Agara (0.087 mg/L) and Udupi (0.0812 mg/L) showed moderate issues. Comparatively, urban lakes had slightly higher salts, aligning with industrialization (NEERI, 2015), but variations highlight site-specific factors.

Lake	Dissolved Oxygen	Dissolved organic matter	Total Hardness	Dissolved salts
1	2.853	1.6	2.41	0.087
2	1.425	1.4	1.4	0.094
3	2.853	1.8	1.8	0.0716
4	4.275	2	2	0.0812
5	8.556	2.6	2.6	0.078

Table 1: Tabular column representing the value of different parameters and the values.

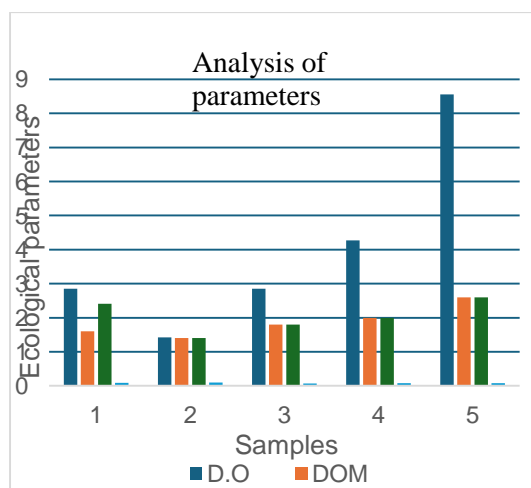


Figure 6: Bar graph showing variation in parameters in five different lakes across Karnataka

Samples	Names of the lake/ place
1	Agara lake
2	Bellandur lake
3	Margondanahalli Lake
4	Udupi Lake
5	Medikeri lake

Table 2: Tabular column representing the names of different lakes

Analysis of the values indicates the following results Dissolved Oxygen (DO): The levels of dissolved oxygen exhibit significant variation among the samples. Sample 5 shows the highest concentration at 8.556 mg/L, while Sample 2 presents the lowest at 1.425 mg/L. Higher levels of dissolved oxygen are generally beneficial

for aquatic life, suggesting that Sample 5 may have better conditions for supporting diverse biological communities compared to the other samples. Dissolved Organic Matter (DOM): The amount of dissolved organic matter ranges from 1.4 to 2.6 mg/L across the samples. Sample 5 has the highest concentration, which could indicate a higher level of organic pollution or nutrient availability. Elevated levels of DOM can affect the water quality and the overall health of aquatic ecosystems by influencing microbial processes. Total Hardness: Data for total hardness suggests a consistent correlation with dissolved organic matter. Most samples exhibit a similar total hardness value, ranging from 1.4 to 2.6 mg/L. This may imply that the hardness levels are moderate and could influence the solubility of minerals and metals in the water. Dissolved Salts: The concentration of dissolved salts is relatively low across all samples, ranging from 0.0716 to 0.094 mg/L. The lowest value is in Sample 3, while Sample 2 has the highest. Lower salt concentrations are typically favorable for freshwater ecosystems, reducing the risk of osmoregulatory stress on aquatic organisms.

## CONCLUSION

The primary outcome of the study is a comprehensive assessment of pollution-induced water quality degradation in five selected lakes in Karnataka (Agara, Bellandur, Margondanahalli, Udupi, and Madikeri). Key findings include significant spatial variations in physicochemical parameters: Dissolved Oxygen (DO) ranged from hypoxic levels (1.425 mg/L in Bellandur Lake) to optimal levels (8.556 mg/L in Madikeri Lake), indicating severe oxygen depletion in urbanized areas; Dissolved Organic Matter (DOM) varied from 1.4 to 2.6 mg/L, with higher values suggesting nutrient enrichment; Total

Hardness ranged from 1.4 to 2.6 mg/L, correlating with DOM; and Dissolved Salts were generally low (0.0716–0.094 mg/L) but highest in polluted sites. Overall, Madikeri Lake showed the best ecological health, while Bellandur Lake exhibited the most severe pollution, with hypoxia and elevated salts posing risks to aquatic life. The study concludes that urbanization, industrialization, and agriculture are major drivers of degradation, predicting potential 60% statewide lake deterioration if unaddressed, and emphasizes the need for targeted interventions to restore ecosystem health and prevent biodiversity loss.

The implications of the study—such as the ecological, economic, and health risks from pollution—are derived from a combination of empirical data, and supporting literature. Specifically- Data and Analysis: Implications stem directly from the measured parameters (e.g., DO levels below 2 mg/L in Bellandur Lake indicate hypoxia, leading to fish kills and anaerobic conditions, as per APHA standards). Based on the study's outcomes and implications, the following evidence-based recommendations are proposed for policy makers (e.g., Ministry of Environment, Forest and Climate Change) and lake authorities (e.g., Karnataka State Pollution Control Board, local municipal bodies) in India. These aim to mitigate pollution, restore lakes, and prevent further degradation, drawing from literature on successful interventions: Implement Immediate Remediation Measures: Prioritize aeration systems in hypoxic lakes like Bellandur to restore DO levels by 50-80%, as demonstrated in global cases. Divert untreated sewage and industrial effluents through upgraded treatment

plants, targeting urban areas to reduce DOM and salts, with potential cost savings from avoided health crises. Adopt Integrated Watershed Management: Establish buffer zones and runoff controls around lakes to filter agricultural and urban inputs, reducing nutrient loads by 30-50% <sup>2</sup>. For rural lakes like Madikeri and Udupi, promote sustainable farming practices (e.g., reduced fertilizer use) to curb hardness and DOM, aligning with NEERI (2015) guidelines for nationwide lake protection. Enhance Monitoring and Enforcement: Develop a centralized GIS-based monitoring network for real-time tracking of parameters, incorporating biomonitoring<sup>4</sup> to detect early pollution. Strengthen enforcement of the Lake Conservation Act (2018) with penalties for violators, and allocate funds for regular audits, as gaps in Karnataka's policies have allowed 70% of urban lakes to remain polluted (KSPCB, 2019). Promote Community and Technological Solutions: Launch public awareness campaigns on pollution sources, involving local communities in lake restoration (e.g., tree planting). Invest in innovative technologies like constructed wetlands for nutrient removal (Kadlec & Wallace, 2009) and rainwater harvesting to replenish water levels, potentially reducing economic losses from degraded tourism and fisheries. Long-Term Policy Framework: Integrate lake health into national plans like the National Water Mission, with inter-state cooperation for shared watersheds.

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